2011

Traumatic Brain Injury in Nebraska 2004-2008

TRAUMATIC BRAIN INJURY IN NEBRASKA 2004-2008

Nebraska Department of Health and Human Services

Joann Schaefer, M.D., Director, Division of Public Health

Ming Qu, Ph.D., Administrator, Public Health Support Unit

Dan Cillessen, M.S.W., Administrator, Public Health Promotion Unit

Lei Zhang, M.S., Administrator, Office of Health Statistics

Report prepared by:

Ericka Welsh, Ph.D., Epidemiology Surveillance Coordinator

Jennifer Marcum, DrPH, CSTE Injury Epidemiology Fellow

Alan Xu, Research Assistant

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For more information about this report, or for questions or comments, please contact:

Injury Prevention Program
Nebraska Department of Health and Human Services
301 Centennial Mall South
P.O. Box 95044
Lincoln, NE 68509
(402) 471-2101

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EXECUTIVE SUMMARY

Traumatic brain injury (TBI) is a major public health problem in Nebraska and the U.S. as a whole. TBIs are often more dangerous than other injuries because of an increased risk for death or permanent disability. From 2004 to 2008, 1,610 Nebraskans died as a result of a traumatic brain injury, and such deaths were more common among males than among females. The age-adjusted rate was noticeably higher for males compared to females. In addition, there were 4,750 hospitalizations and 30,265 emergency department (ED) visits for TBI. Importantly, TBI-related hospitalizations and ED visits increased from 42.2 hospitalizations and 255 ED visits per 100,000 persons in 2004, to 62.0 hospitalizations and 412.5 ED visits per 100,000 persons in 2008.

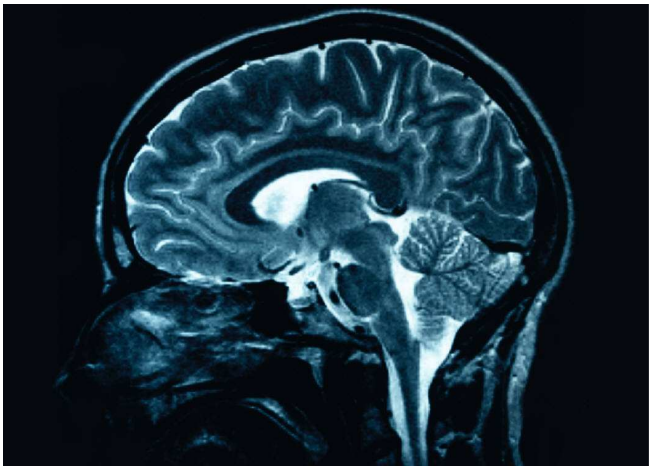
The leading cause of TBI death was motor vehicle traffic accidents (n=591), followed by firearms (n=419) and falls (n=383). These three causes accounted for more than 85% of all TBI deaths from 2004 to 2008 in Nebraska. Notably, TBI deaths due to firearms were approximately ten times more common among males (n=382) than among females (n=37).

Unintentional falls accounted for over half (approximately 53%) of all TBI-related hospitalizations and ED visits. Motor vehicle crashes and struck by/against injuries were the second and third leading causes of TBI-related hospitalizations, respectively, while struck by/against injuries and motor vehicle crashes were the second and third leading causes for ED visits, respectively. Although TBIs due to unintentional falls were most common, in general, TBIs resulting from motor vehicle crashes and firearms were more serious (more likely to result in death or hospitalization).

For both hospitalizations and ED visits, commercial insurance, Medicare, and Medicaid were the expected primary payer for over 85% of all cases. Medicare and commercial insurance were each the expected primary payer for about 40% of all TBI-related hospitalizations in Nebraska. On the other hand, commercial insurance was most frequently (54%) the expected primary payer for TBI-related ED visits, while Medicaid and Medicare each accounted for about 16%.

Although TBIs were a fraction of overall injury, the consequences of TBI were often far more grave than other injuries. For TBI-related cases, the ratio of deaths to emergency department visits was over three times larger than the ratio of deaths to emergency department visits for overall injury. Because of the increased probability of serious consequence, TBI deserves a focused look in the scope of overall injury surveillance. The Nebraska Trauma Registry and Crash Outcomes Data Evaluation System (CODES) are two sources of data that could be utilized in the future to expand TBI surveillance in the state.

INTRODUCTION



Traumatic brain injury (TBI) is caused by a bump, blow or jolt to the head or a penetrating head injury that disrupts the normal function of the brain. According to the Centers for Disease Control and Prevention, TBI is a serious public health problem in the United States. Each year, TBIs contribute to a substantial number of deaths and cases of permanent disability. Each year, about 1.5 million Americans sustain a TBI. Of these 1.5 million, about 50,000 die as a result. Although the majority of TBIs aren't fatal, they can cause long-term health complications, such as loss of function or permanent disability. Currently, about 5.3 million Americans are living with a TBI-related disability, and 85,000 persons each year will sustain a TBI that results in a permanent disability. One study estimated that TBI costs (including direct medical costs and indirect costs such as lost productivity) totaled approximately $60 billion in the United States in 2000 (Source: Finkelstein E, Corso P, Miller T and associates. The Incidence and Economic Burden of Injuries in the United States. New York (NY): Oxford University Press; 2006.)

Traumatic brain injury has many short term and long term effects. Short term effects include loss of consciousness, retrograde amnesia, and changes in mental state. Long term effects can be grouped into three categories: (1) neurological/physical effects, including post traumatic epilepsy, sensory deficit, impaired strength and coordination, and pain; (2) cognitive effects, such as memory impairment, slowed processing speed, decreased intelligence, and impaired executive functioning, and (3) psychosocial/emotional effects, including rapid shifts in outward emotional expressions, social inappropriateness, mood swings, stress/anxiety, and depression.

In 1989, the CDC began to promote development of multistate TBI surveillance systems. In 1996, Congress passed the Traumatic Brain Injury Act, which gave the CDC the responsibility of developing projects to reduce the incidence of TBI, including a uniform reporting system, increased research efforts, and awareness programs. The TBI Act was reauthorized in 2000 under the Children's Health Act.

The intent of this report is to inform public health practitioners, policymakers, and the general public about the burden of traumatic brain injury in Nebraska in order to design and implement effective preventative measures against TBI.

TRAUMATIC BRAIN INJURY-RELATED DEATHS IN NEBRASKA

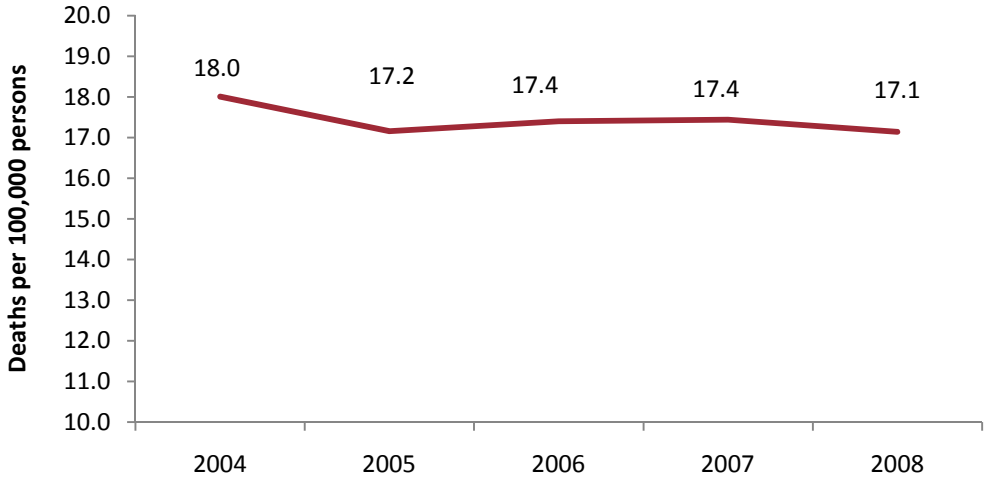
Age-adjusted rates by gender

From 2004 to 2008, there were 1,610 deaths in Nebraska involving a traumatic brain injury (TBI). The overall age-adjusted rate for TBI-related deaths was 17.4 per 100,000 persons. The age-adjusted rate was noticeably higher for males compared to females (26.3 deaths per 100,000 males vs. 9.5 deaths per 100,000 females).

Trends

During this time period, the overall age-adjusted rate for TBI-related deaths remained approximately the same. *Figure 1.*

Figure 1: Age-adjusted rates for TBI-deaths by year, Nebraska residents, 2004-2008

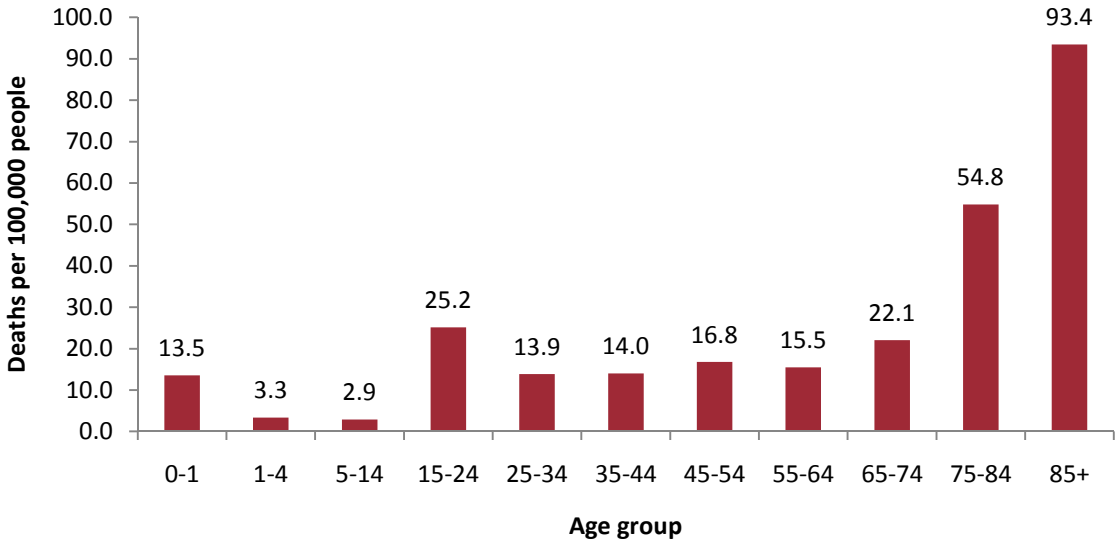


Source: NE death certificates, 2004-2008

Age-specific rates

The average age-specific rate for TBI-related deaths was highest among older adults aged 85 years and older (93.4 deaths per 100,000 persons), and second highest for older adults ages 75-84 years (54.8 deaths per 100,000 persons). Rates were also relatively higher among young adults ages 15-24 years (25.2 deaths per 100,000). *Figure 2.*

Figure 2: Age-specific rates for TBI-related deaths, Nebraska residents, 2004-2008



Source: NE death certificates, 2004-2008

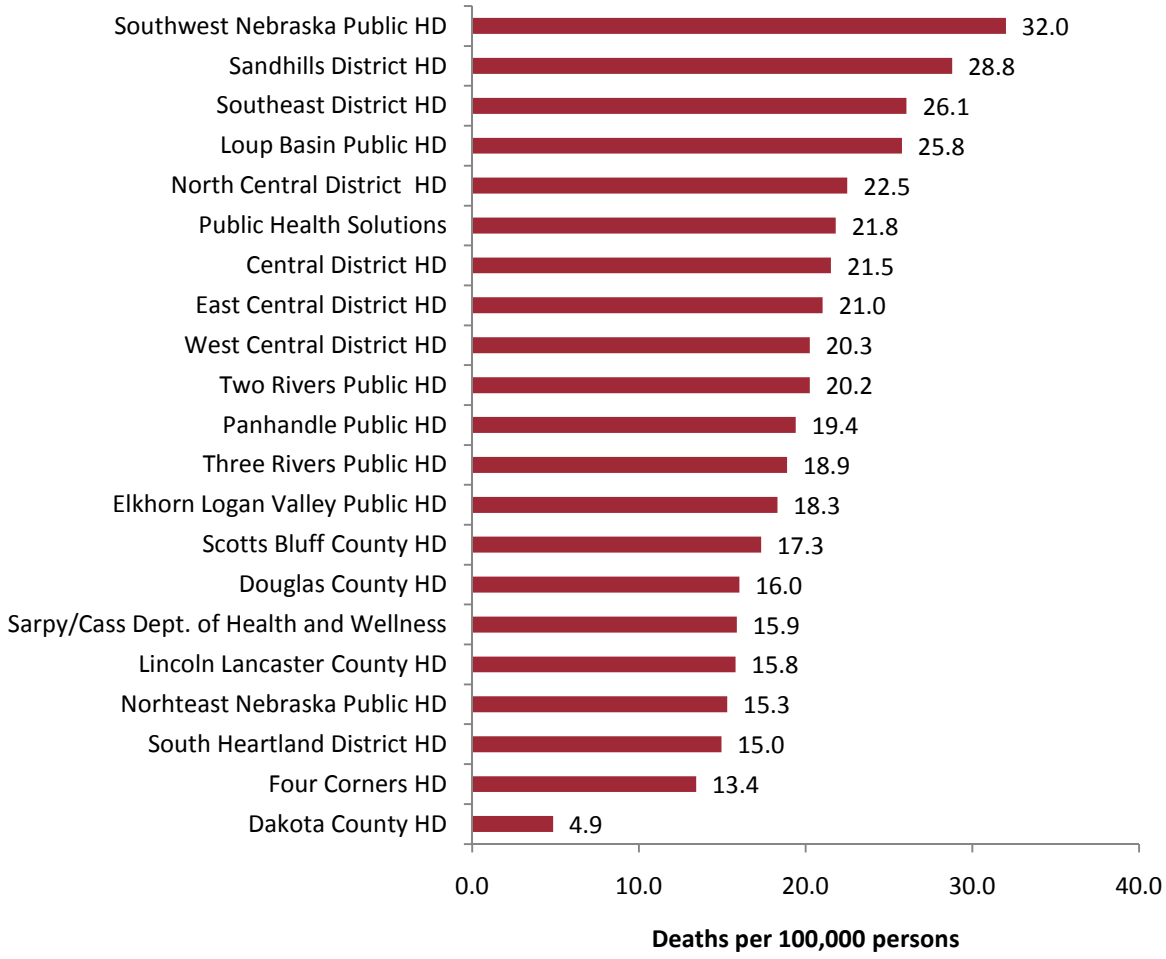
National TBI-related death rates

National TBI-related death rates were approximately the same as Nebraska's. In the U.S. from 2002-2006, the TBI-related death rate per 100,000 persons was 17.4 overall, 27.1 for males, and 8.6 for females. Nationally, the TBI-related death rate per 100,000 persons was 19.2 for 15-19 year olds and 24.3 for 20-24 year olds. In Nebraska, the TBI-related death rate was 25.2 per 100,000 persons aged 15-24 year old.

Age-adjusted rates by local/district health department service area

The average age-adjusted rate for TBI-related deaths from 2004 to 2008 varied across the 21 local/district health departments in Nebraska. The highest age-adjusted rate was 32 deaths per 100,000 persons in the Southwest Nebraska Public Health Department's service area, and the lowest age-adjusted rate was 4.9 deaths per 100,000 persons in the Dakota County Health Department's service area. It is important to note that deaths that occur out-of-state are not included in this report. The Dakota County Health Department service area borders northwest Iowa where residents are likely to go for medical care. If out-of-state deaths are included, the rate for Dakota County Health Department approximately doubles to 10 deaths per 100,000 persons. *Figure 3.*

Figure 3: Age-adjusted rates for TBI-related deaths by local/district health department service area, Nebraska residents, 2004-2008



Source: NE death certificates, 2004-2008

Intent of TBI-related deaths, by gender

Among females, 86% of TBI-related deaths were due to unintentional injury, 12% were due to intentional injury (5% suicide, 7% homicide), and the remaining 2% were either of undetermined intent or due to adverse effects.

Among males, 63% of TBI-related deaths were due to unintentional injury, 36% were due to intentional injury (29% suicide, 7% homicide), and the remaining 1% were due to legal/war or undetermined intents.

Leading causes of TBI-related deaths, by gender

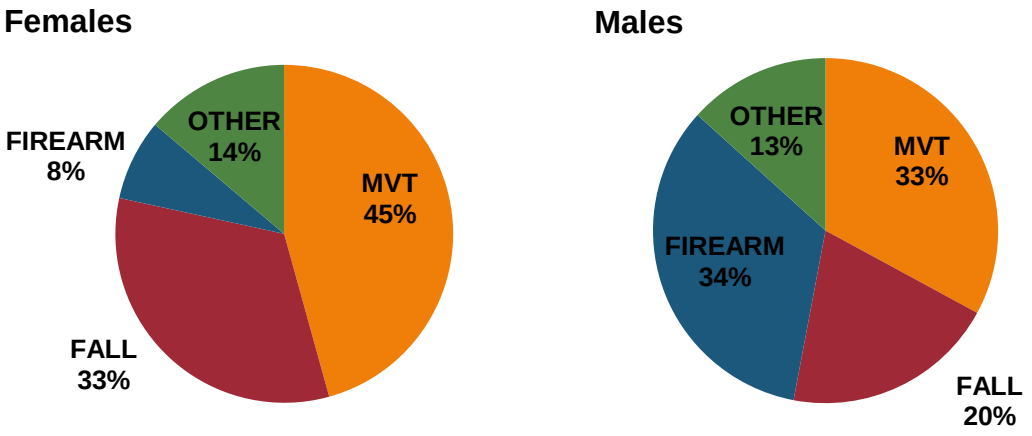
Among females, 45% of TBI-related deaths were due to motor vehicle traffic (MVT) crashes, 33% were due to falls, 8% were due to firearm injuries, and the remaining 14% were due to other causes.

Among males, 33% of TBI-related deaths were due to MVT crashes, 20% were due to falls, 34% were due to firearm injuries, and the remaining 13% were due to other causes. *Figure 4.*

Among TBI-related deaths due to firearm injuries, 82% were suicide, 15% were homicide, and the remaining 3% were unintentional or undetermined intent.

Leading causes of TBI-related deaths were similar across local/district health department service areas.

Figure 4: TBI-related deaths, by cause and gender, Nebraska residents, 2004-2008



Source: NE death certificates, 2004-2008

TRAUMATIC BRAIN INJURY-RELATED HOSPITALIZATIONS IN NEBRASKA

Age-adjusted rates by gender

From 2004 to 2008, there were 4,750 hospitalizations in Nebraska involving a traumatic brain injury (TBI). The overall age-adjusted rate for TBI-related hospitalizations was 50.9 hospitalizations per 100,000 persons. The age-adjusted rate was nearly twice as high for males compared to females (67.2 hospitalizations per 100,000 males vs. 35.9 hospitalizations per 100,000 females). *Table 1.*

Table 1: Age-adjusted rates for TBI-related hospitalizations and emergency department (ED) visits, by gender and year, Nebraska residents, 2004-2008

		Females			Males			Total		
	Year	N	%	Rate	N	%	Rate	Total	%	Rate
Hospitalizations	2004	282	14.9%	27.8	491	17.2%	58.5	773	16.3%	42.2
	2005	308	16.3%	29.5	519	18.2%	61.6	827	17.4%	44.8
	2006	378	20.0%	35.9	521	18.2%	61.0	899	18.9%	48.0
	2007	441	23.3%	41.8	623	21.8%	73.0	1064	22.4%	57.0
	2008	482	25.5%	43.9	705	24.7%	81.6	1187	25.0%	62.0
	Total	**1891**	**100.0%**	**35.9**	**2859**	**100.0%**	**67.2**	**4750**	**100.0%**	**50.9**
ED Visits	2004	1941	14.6%	213.5	2598	15.3%	295.6	4539	15.0%	255.0
	2005	2132	16.1%	232.8	2827	16.6%	319.0	4959	16.4%	277.1
	2006	2722	20.5%	294.8	3447	20.3%	388.1	6169	20.4%	343.4
	2007	3173	23.9%	345.2	3927	23.1%	443.4	7100	23.5%	395.0
	2008	3301	24.9%	352.5	4197	24.7%	469.3	7498	24.8%	412.5
	Total	**13269**	**100.0%**	**288.0**	**16996**	**100.0%**	**383.5**	**30265**	**100.0%**	**337.0**

Source: NE hospital discharge data, 2004-2008

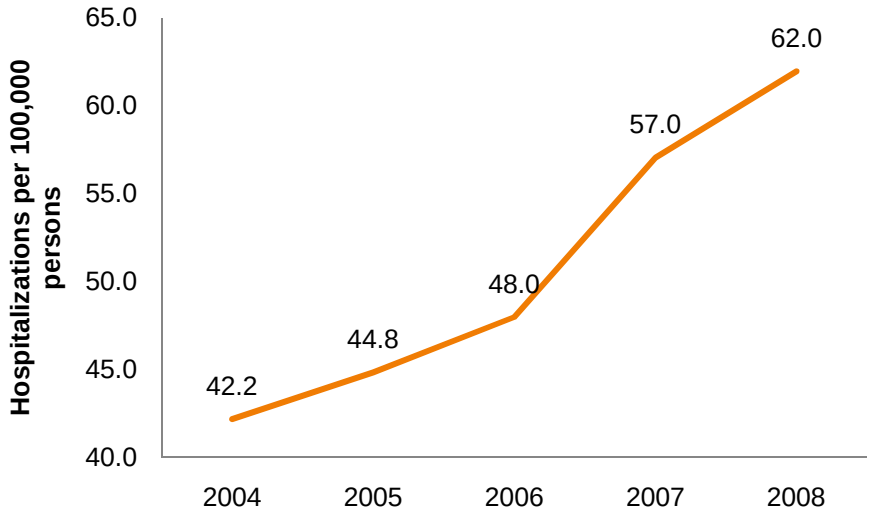
Trends

During this time period, the overall age-adjusted rate for TBI-related hospitalizations increased steadily from 42.2 per 100,000 persons in 2004 to 62.0 per 100,000 persons in 2008. *Figure 5.*

Age-specific rates

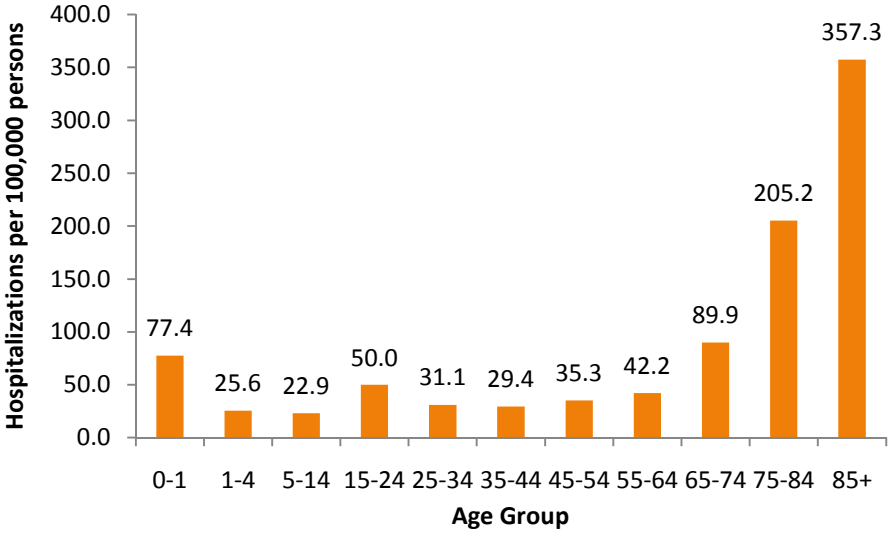
The average age-specific rate for TBI-related hospitalizations from 2004 to 2008 was highest among Nebraska adults aged 85 years and older (357 hospitalizations per 100,000 persons). *Figure 6*.

Figure 5: Age-adjusted rates for TBI-related hospitalizations by year, Nebraska residents, 2004-2008



Source: NE hospital discharge data, 2004-2008

Figure 6: Age-specific rates for TBI-related hospitalizations, Nebraska residents, 2004-2008



Source: NE hospital discharge data, 2004-2008

National TBI-related hospitalization rates

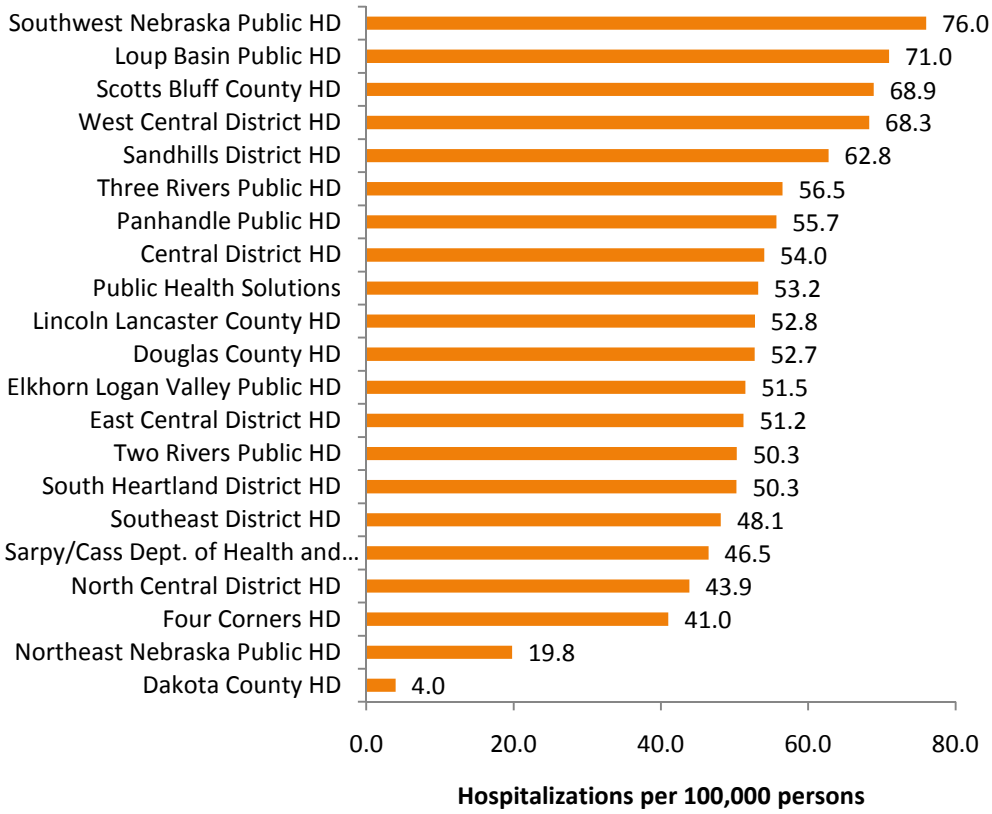
National TBI-related hospitalization rates were nearly twice as high as Nebraska's. From 2002-2006, the national hospitalization rate per 100,000 persons was 93.6 overall, 121 for males, and 66.2 for females. Nationally, TBI-related hospitalization rates were 119.9 per 100,000 persons aged 15-19 years

old and 99.7 per 100,000 persons aged 20-25 years old, compared to 50 per 100,000 persons aged 15-24 years old in Nebraska.

Age-adjusted rates by local/district health department service area

The average age-adjusted rate for TBI-related hospitalizations from 2004 to 2008 varied across the 21 local/district health department service areas in Nebraska. The highest age-adjusted rate was 76 hospitalizations per 100,000 persons in Southwest Nebraska Public Health Department's service area, and the lowest age-adjusted rate was 4 hospitalizations per 100,000 persons in the Dakota County Health Department's service area. It is important to note that out-of-state hospitalizations are not included in this report. The Dakota County and Northeast Nebraska Public Health Department service areas border northwest Iowa where residents are likely to go for medical care. *Figure 7.*

Figure 7: Age-adjusted rates for TBI-related hospitalizations by local/district health department service area, Nebraska residents, 2004-2008



Source: NE hospital discharge data, 2004-2008

Intent of TBI-related hospitalizations, by gender

Among females, 95% of TBI-related hospitalizations were due to unintentional injury, 3% were due to assault, and the remaining 2% were due to self-inflicted, undetermined, or unknown intent.

Among males, 88% of TBI-related hospitalizations were due unintentional injury, 8% were due to assault, and the remaining 4% were due to self-inflicted, undetermined, or unknown intent.

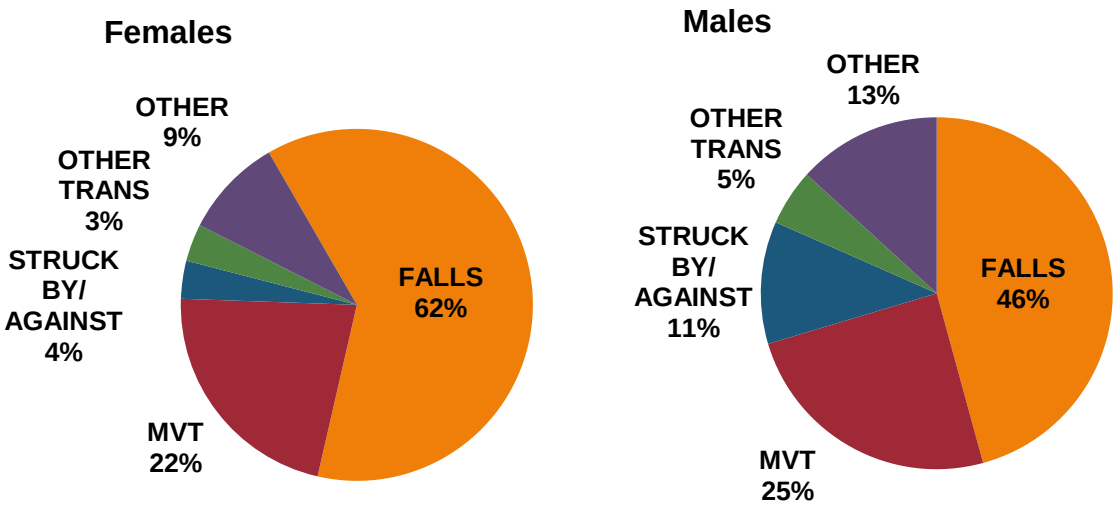
Leading causes of TBI-related hospitalizations, by gender

Among females, 62% of TBI-related hospitalizations were due to falls, 22% were due to motor vehicle traffic (MVT) crashes, and the remaining 16% were due to struck by/against injuries, other transportation injuries or other causes.

Among males, 46% of TBI-related hospitalizations were due to falls, 25% were due to motor vehicle traffic (MVT) crashes, and the remaining 29% were due to struck by/against injuries, other transportation injuries or other causes. *Figure 8.*

Leading causes of TBI-related hospitalizations were similar across local/district health department service areas.

Figure 8: TBI-related hospitalizations, by cause and gender, Nebraska residents, 2004-2008

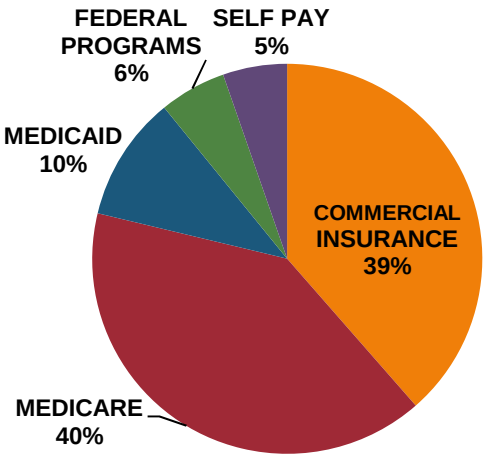


Source: NE hospital discharge data, 2004-2008

Median hospital charge and expected primary payer

From 2004 to 2008, the median hospital charge for TBI-related hospitalizations was $17,152. During this same time period, 50% of TBI-related hospitalizations were billed to Medicare or Medicaid, with the remaining billed to commercial insurance, federal programs, or directly to the patient (i.e. self-pay). *Figure 9.*

Figure 9: TBI-related hospitalizations, by expected primary payer, Nebraska residents, 2004-2008



Source: NE hospital discharge data, 2004-2008

TRAUMATIC BRAIN INJURY-RELATED EMERGENCY DEPARTMENT VISITS IN NEBRASKA

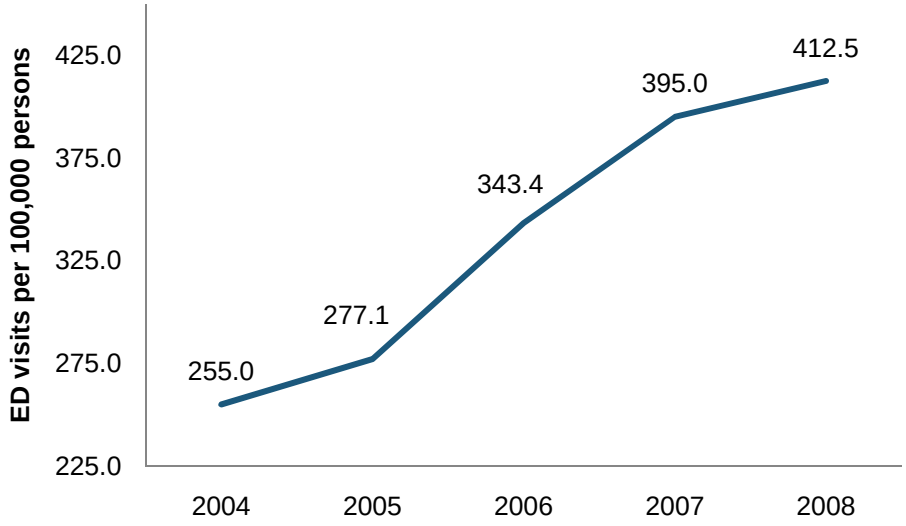
Age-adjusted rates by gender

From 2004 to 2008, there were 30,265 emergency department (ED) visits in Nebraska involving a traumatic brain injury (TBI). The overall age-adjusted rate for TBI-related ED visits was 337 ED visits per 100,000 persons. The age-adjusted rate was noticeably higher for males compared to females (383.5 ED visits per 100,000 males vs. 288 ED visits per 100,000 females). *Table 1.*

Trends

During this time period, the overall age-adjusted rate for TBI-related ED visits increased steadily from 255 per 100,000 in 2005 to 412.5 per 100,000 persons in 2008. *Figure 10.* This increase is attributed mostly to an increase in unspecified head injuries (see Appendix: Methodology, p.22).

Figure 10: Age-adjusted rates for TBI-related emergency department (ED) visits by year, Nebraska residents, 2004-2008

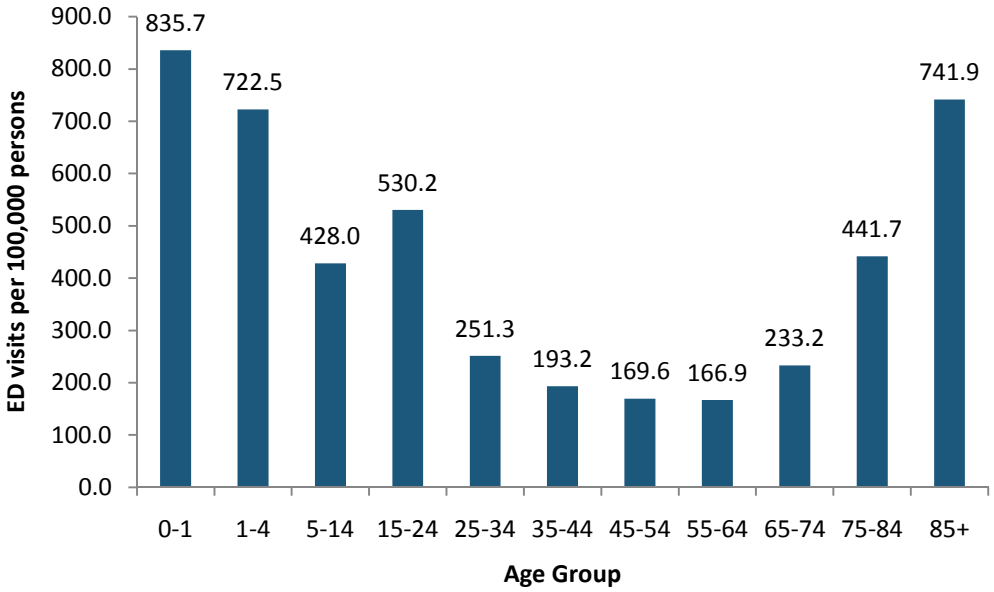


Source: NE hospital discharge data, 2004-2008

Age-specific rates

The average age-specific rate for TBI-related ED visits from 2004 to 2008 was highest among Nebraska infants less than 1 year of age (836 ED visits per 100,000 infants). Rates were also high for children ages 1-4 years (723 ED visits per 100,000 children) and older Nebraskans aged 85 years and older (742 ED visits per 100,000 persons). *Figure 11*.

Figure 11: Age-specific rates for TBI-related emergency department (ED) visits, Nebraska residents, 2004-2008



Source: NE hospital discharge data, 2004-2008

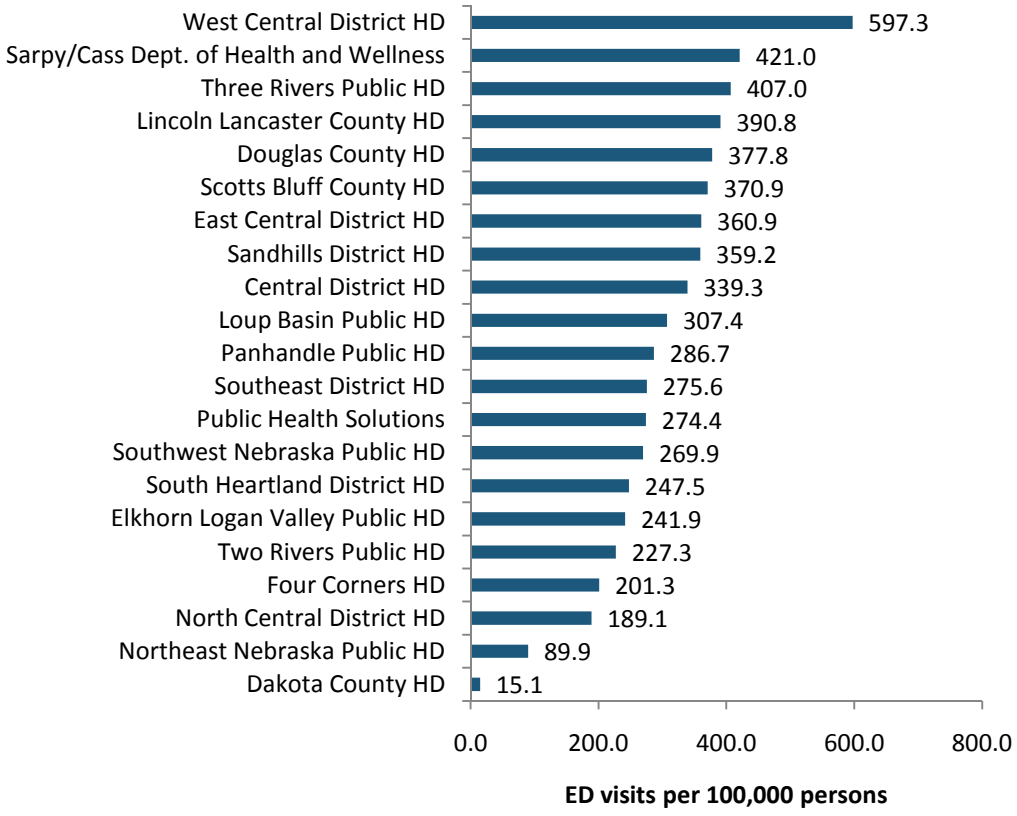
National TBI-related ED visit rates

Nebraska TBI-related ED visit rates were much lower than the national average. From 2002-2006, the U.S. had an ED visit rate of 468 per 100,000 persons, compared to 337 per 100,000 persons in Nebraska. Similarly, national rates for males and females were also much higher. For males, the national rate was 543.9 per 100,000 persons, compared to Nebraska's rate of 383.5 per 100,000 persons. For females, the national rate was 388.6 per 100,000 persons, compared to Nebraska's rate of 288 per 100,000 females.

Age-adjusted rates by local/district health department service area

The average age-adjusted rate for TBI-related ED visits from 2004 to 2008 varied across the 21 local/district health departments in Nebraska. The highest age-adjusted rate was 597 ED visits per 100,000 persons in West Central District Health Department's service area, and the lowest age-adjusted rate was 15 ED visits per 100,000 persons in the Dakota County Health Department's service area. It is important to note that out-of-state ED visits are not included in this report. The Dakota County and Northeast Nebraska Public Health Department service areas border northwest Iowa where residents are likely to go for medical care. *Figure 12.*

Figure 12: Age-adjusted rates for TBI-related emergency department (ED) visits by local/district health department service area, Nebraska residents, 2004-2008



Source: NE hospital discharge data, 2004-2008

Intent of TBI-related emergency department (ED) visits, by gender

Among females, 93% of TBI-related ED visits were due to unintentional injury, 6% were due to assault, and the remaining <1% were due to self-inflicted, undetermined, or unknown intent.

Among males, 89% of TBI-related ED visits were due unintentional injury, 10% were due to assault, and the remaining <1% were due to self-inflicted, undetermined, or unknown intent.

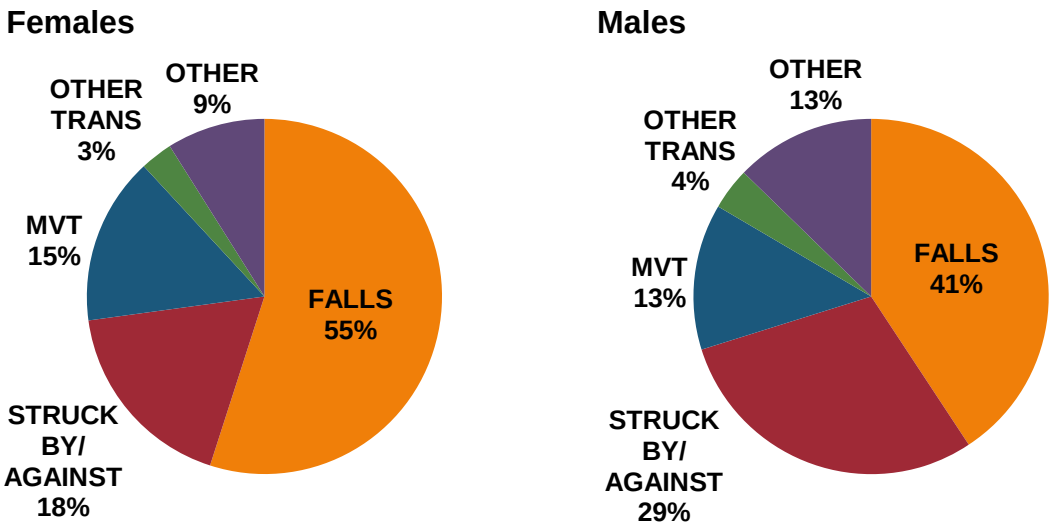
Leading causes of TBI-related emergency department (ED) visits, by gender

Among females, 55% of TBI-related ED visits were due to falls, 18% were due to struck by/against injuries, 15% were due to motor vehicle traffic (MVT) crashes, and the remaining 12% were due to other transportation injuries or other causes.

Among males, 41% of TBI-related ED visits were due to falls, 29% were due to struck by/against injuries, 13% were due to motor vehicle traffic (MVT) crashes, and the remaining 17% were due to other transportation injuries or other causes. *Figure 13.*

Leading causes of TBI-related ED visits were similar across local/district health department service areas.

Figure 13: TBI-related emergency department (ED) visits, by cause and gender, Nebraska residents, 2004-2008

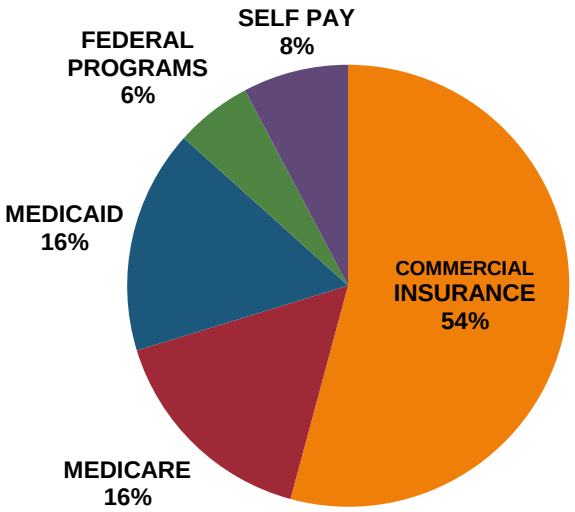


Source: NE hospital discharge data, 2004-2008

Median hospital charge and expected primary payer

From 2004 to 2008, the median hospital charge for TBI-related ED visits was $1,664. During this same time period, 50% of TBI-related hospitalizations were billed to Medicare or Medicaid, with the remaining billed to commercial insurance, federal programs, or directly to the patient (i.e. self-pay). *Figure 14.*

Figure 14: TBI-related emergency department (ED) visits, by expected primary payer, Nebraska residents, 2004-2008



Source: NE hospital discharge data, 2004-2008

CONCLUSIONS

Traumatic brain injury is a serious public health problem in Nebraska. Over the five years outlined in this report, TBI-related death rates remained relatively consistent –dropping slightly from 18 per 100,000 persons to 17.1 per 100,000 persons. However, TBI-related hospitalizations and ED visits increased noticeably. Hospitalization rates increased nearly 50%, from 42.2 per 100,000 persons in 2004 to 62.0 per 100,000 persons in 2008, while ED visit rates increased over 60% from 255.0 per 100,000 in 2004 to 412 per 100,000 in 2008. This increase is attributed mostly to an increase in unspecified head injuries.

TBI death and hospitalization rates were higher for older Nebraskans (especially over the age of 75). Nebraskans age 15-24 years also had disproportionately high TBI rates. The three major causes of traumatic brain injury were falls, motor vehicle crashes, and struck by/against injuries. Unintentional falls and motor vehicle crashes often resulted in more serious injuries requiring hospitalization.

The U.S. Department of Health and Human Services' *Healthy People 2020* outlines several 10-year goals to improve the health of Americans. Among them is a 10% decrease in all TBI rates: deaths, hospitalizations, and ED visits. Although Nebraska's rates are on average lower than national TBI rates, Nebraska hospitalization and ED visit rates have been climbing dramatically.

RECOMMENDATIONS

Surveillance

Due to the prevalence and consequences of TBI in Nebraska, continued surveillance of TBI remains a priority. The Nebraska Trauma Registry and the Nebraska Crash Outcomes Data Evaluation System (CODES) are two sources of data that could be utilized in the future to expand TBI surveillance in the state. These data sources can provide additional information on contributing factors for TBI, such as motor vehicle crash circumstances, as well as race/ethnicity of individuals treated for TBI.

Prevention

The following TBI-prevention strategies are recommended by the CDC's National Center for Injury Prevention and Control (www.cdc.gov/traumaticbraininjury).

- Falls are the leading cause of TBI.
  - Remove tripping hazards in the home.
  - Install handrails.
  - Use a step stool to reach objects on high shelves.
  - Use non-slip mats in bathroom and shower floors.
  - Maintain a regular exercise program to improve strength and balance.
  - See an eye doctor regularly for a vision check to lower the risk of falling.

- Motor vehicle traffic is a major cause of TBI, especially for young adults.
  - Always wear a seatbelt.
  - Never drive under the influence of alcohol or drugs.
  - Always buckle children into a safety seat, booster seat, or seatbelt according to the child's height, weight, and age.

- Other tips and advice
  - Always wear a helmet while playing contact sports, riding bikes, skateboards, or horses, using skates, skiing, or snowboarding.
  - Keep firearms stored unloaded in a locked cabinet or safe.
  - Ensure the surface of your child's playground is a shock-absorbing material.

APPENDIX: METHODOLOGY

Definitions

Age-adjusted rate: A rate that has been standardized to the age distribution of a particular population, so that it is independent of the age distribution of the population it presents. Age-adjusted rates are used to compare rates over time or between different population groups.

Age-specific rate: A rate for a specified age group is calculated by dividing the actual number of cases in a given period (e.g., 2004-2008) for a specific age group by the population in that age group for that period. The numerator and the denominator refer to the same age group.

E-codes: The external cause of injury codes (E-codes) are a subset of the International Classification of Diseases, and are used to classify the environmental events, circumstances, and conditions that are the cause of injury, poisoning, or other adverse effects.

Hospitalization: Discharge record indicating a patient who was in hospital care for longer than 24 hours.

ICD-9-CM: The International Classification of Diseases, Ninth Revision, Clinical Modification coding system is used to classify diagnoses on inpatient and outpatient care records.

ICD-10: The International Classification of Diseases, Tenth Revision, is the coding system used to classify the causes of death listed on death certificates.

Intent of injury: Intentional injuries, such as homicide and suicide, involve acts in which there is intent to kill or harm. Unintentional injuries involve acts in which there is no intent to harm; these injuries are sometimes labeled as “accidental.” In some cases, the intentionality has not been determined. These injuries are categorized as “undetermined intent.”

Mechanism of injury: The activities or circumstances that led to the traumatic brain injury death or hospitalization (e.g., fall, motor vehicle crash, etc.).

Rate: The number of deaths or hospital discharge records per 100,000 persons.

Underlying cause of death: Defined by the World Health Organization as the disease or injury that initiated the chain of events leading directly to death; or the circumstances of the accident or violence, which produced the fatal injury. Most standard mortality data are compiled by underlying cause of death.

Data sources

Death certificates

Death certificates containing information about Nebraska residents are compiled by the Nebraska Department of Health and Human Services (DHHS) Office of Vital Records. Death certificates classify injuries by external cause of death. Primary causes of death were coded based on the International Classification of Diseases-10th Revision (ICD-10) and are presented based on the external cause-of-injury mortality matrix. Traumatic brain injury death was defined in accordance with the Centers for Disease Control and Prevention (CDC) and State and Territorial Injury Prevention Directors Association (STIPDA) *State Injury Indicators: Instructions for Preparing 2005 Data* (2007), and includes deaths with any of the following ICD-10 codes in any field of the multiple cause of death file:

Traumatic Brain Injury Fatality ICD-10 Codes

S01.0–S01.9	Open wound of head
S02.0, S02.1, S02.3, S02.7–S02.9	Fracture of skull and facial bones
S04.0	Injury of optic nerve and pathways
S06.0–S06.9	Intracranial injury
S07.0, S07.1, S07.8, S07.9	Crushing injury of head
S09.7–S09.9	Other and unspecified injuries of head
T01.0*	Open wounds involving head with neck
T02.0*	Fractures involving head with neck
T04.0*	Crushing injuries involving head with neck
T06.0*	Injuries of brain and cranial nerves with injuries of nerves and spinal cord at neck level
T90.1, T90.2, T90.4, T90.5, T90.8, T90.9	Sequelae of injuries of head

* These codes are not considered valid in the US

Hospital discharge data

Hospital discharge data (HDD) is generated from uniform hospital billing forms which contain records of patient discharge information, excluding names. This information is provided by Nebraska acute care hospitals to the Nebraska Hospital Association (NHA), using the 2004 Uniform Billing form (UB-04). The E-code data, a subset of HDD containing injury related records, is provided to the Nebraska Department of Health and Human Services (DHHS) by the NHA.

Hospitalizations due to traumatic brain injury were defined in accordance with the Centers for Disease Control and Prevention (CDC) and State and Territorial Injury Prevention Directors Association (STIPDA) *State Injury Indicators: Instructions for Preparing 2005 Data* (2007), and includes hospital discharge records with any of the following International Classification of Diseases,

Ninth Revision, Clinical Modification (ICD-9-CM) diagnostic codes in any of the diagnostic fields of the E-code data subset:

Traumatic Brain Injury Hospitalization ICD-9-CM Codes

Diagnosis codes	
800.00-801.99	Fracture of the vault or base of the skull
803.00-804.99	Other and unqualified or multiple fractures of the skull
850.0-850.9	Concussion
851.00-854.19	Intracranial injury, including contusion, laceration, and hemorrhage
950.1-950.3	Injury to the optic chiasm, optic pathways, or visual cortex
959.01	Head injury, unspecified
995.55	Shaken infant syndrome

A limitation of hospital discharge data is that it is record-based; therefore, one patient may be counted more than once if discharged for the same injury more than once. *The rates displayed in this report reflect numbers of discharge records, rather than numbers of patients discharged.*

Analysis

The frequency, age-specific, and age-adjusted rates for traumatic brain injury deaths and hospitalizations in Nebraska are presented in this report. All results are based on analyses of deaths and hospital discharges of Nebraska residents. Nebraska residents who died outside of Nebraska or were treated at hospitals out of the state are not included. Thus, rates may be underestimated if Nebraskans died or were treated in other states.

Five-year averages are used throughout the report to provide more stable rates by reducing the effects of fluctuations from year to year for groups with small numbers of injury events.

Age-adjusted rates

All age-adjusted rates presented in this report are per 100,000 Nebraska residents and are age adjusted to the 2000 U.S. standard population using the direct method applied to eleven age groups. Direct age adjustment involves the application of age-specific rates in a population of interest to a standardized age distribution (i.e., that of the U.S.) in order to eliminate differences in observed rates that result from age differences between populations. This adjustment is usually done when comparing two or more populations at one point in time or one population at two or more points in time.

Age-adjusted rates (AAR) are calculated by the direct method as follows:

$$AAR = \text{Summation of } (ASR_i * weight_i)$$

Where ASR_i = the age-specific rates for the population of interest
$Weight_i$ = the standard weight in age group *i*